COULOMB EXCITATION AT THE WARSAW CYCLOTRON * **

J. Iwanicki[a], J. Choiński[a], T. Czosnyka[a], J. Kownacki[a], M. Kisielński[a], P. Napiorkowski[a], L. Zemło[a], J. Srebrny[b], J. deBoer[c], M. Loewe[c], and M. Würkner[c]

[a]Heavy Ion Laboratory of Warsaw University, Poland
[b]Institute of Experimental Physics, Warsaw University, Poland
[c]Sektion Physik, Universität München, Germany

(Received December 10, 1996)

The results of first Coulomb Excitation experiments at the Heavy Ion Laboratory of Warsaw University are presented for two very different nuclei: ^{150}Nd (a subject of an extensive Coulex project in the past few years) and ^{19}F, not investigated by Coulex up to now. New detector system, dedicated to Coulex experiments is also presented.

PACS numbers: 29.30. Kv, 25.70. De

1. Introduction

Shortly after first extracted beams become available from the Warsaw Cyclotron and before the final experimental arrangement was completed, simple Coulomb excitation experiments were performed to answer specific questions. In the meantime, dedicated high efficiency multidetector system was designed and built.

2. ^{150}Nd

^{150}Nd nucleus was a subject of extensive Coulomb excitation project in the last few years [1]. An experiment made in Warsaw using the low energy ^{14}N beam was favouring one-step E4 transition. Since all quadrupole matrix elements connecting three lowest excited states in the ground state band

* Presented at the XXXI Zakopane School of Physics, Zakopane, Poland, September 3–11, 1996.
** Work supported by Polish State Committee for Scientific Research grant PB 255/P03/95/08.

(0^+,2^+,4^+, see Fig. 1) are known the only non-negligible mode of exciting 4^+ state is direct one-step E4, favoured at such a low energy in comparison with E2×E2 cascade. Measured ratio of $(4^+ \rightarrow 2^+)/(2^+ \rightarrow 0^+)$ yielded a value of $B(\mathrm{E4}) = 0.010(2)e^2b^4$, which means that hexadecapole degree of freedom can be safely neglected.

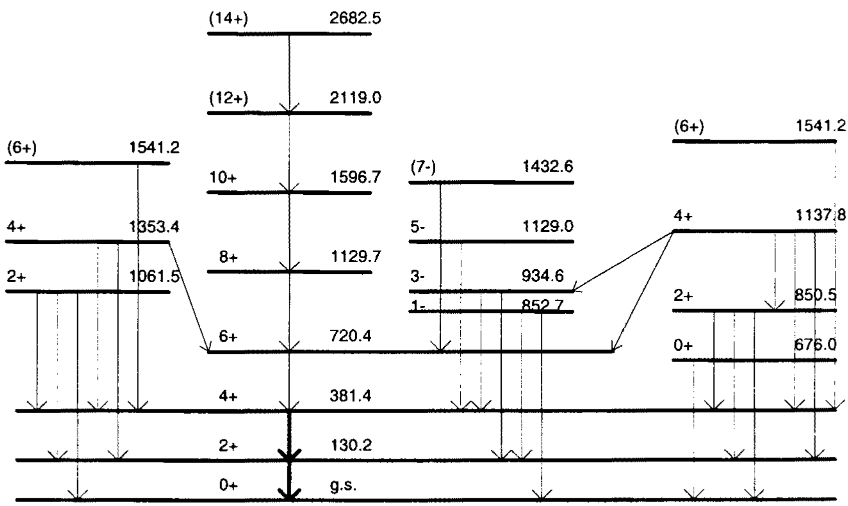

Fig. 1. Level scheme of ^{150}Nd. The two lowest states were excited selectively to determine the influence of E4 matrix element.

3. ^{19}F

^{19}F nucleus is the one suspected to have octupole deformation and the lightest one studied by Coulomb excitation. The experiments with fluorine beam excitation were performed at HIL (Warsaw) and NBI (Risø).

Level scheme of the investigated nucleus is known from many reaction and decay studies [2] (see Fig. 2); available spectroscopy data (lifetimes, branching and mixing ratios) define most of the E1, E2 and M1 matrix elements. A question about collective octupole deformation and related E3 transition matrix elements can be answered only by Coulomb excitation where excitation process description is precise enough. Deexcitation data is not sensitive to E3 transitions which cannot compete with faster modes of decay. Data collected on nickel, silver and hafnium targets, along with spectroscopic data let us to determine the influence of E3 on the population pattern and observed deexcitation. Preliminary results point out to

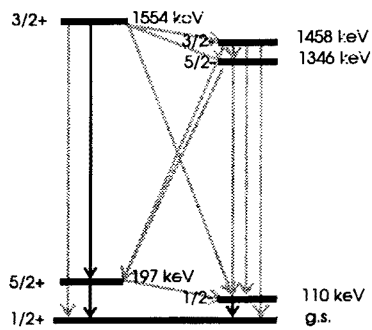

Fig. 2. Low lying states of ^{19}F. All the life times and most of the branching ratios are known from the literature. Solid black lines show the transitions observed.

unexpectedly large E3 moment. This result will be verified using new detector array.

4. CUDAC

CUDAC — Coulex Universal Detector Array Chamber is a tool dedicated to Coulomb Excitation experiments [3]. It is an aluminium-steel chamber which can be equipped with different particle detection systems. The chamber was designed to assure maximum 0.5% Doppler broadening for 1 cm^2 particle detector at worst kinematic conditions (fast and heavy projectile). The broadening effect analysis yielded 10 cm particle detector-target distance. Gamma detection solid angle is maximized by the relatively flat shape of the chamber (see Fig. 4). 300 vacuum-sealed signal pins are ready to be used now.

CUDAC is intended to cooperate with some external gamma ray detection system. In the simple case one to four stand-alone gamma detectors may be placed around in the horizontal plane. Its six-fold symmetry allows for making use of OSIRIS detector system, moved to Warsaw recently and expected to be operating in the next month.

Up to now planar large area mosaic silicon detector was tested inside CUDAC chamber and new PIN diode array is ready for tests (see Fig. 3). The array consists of 65 1×1 cm PIN diodes (the number of them may be enlarged if necessary) and covers about 5% of full solid angle.

Coulomb Excitation experiments kinematics is uniquely determined by the projectile scattering angle. Particle energy is possible to recover from the reconstructed kinematics, so it does not need to be measured directly. The electronics needed for the array may be simplified to the single particle

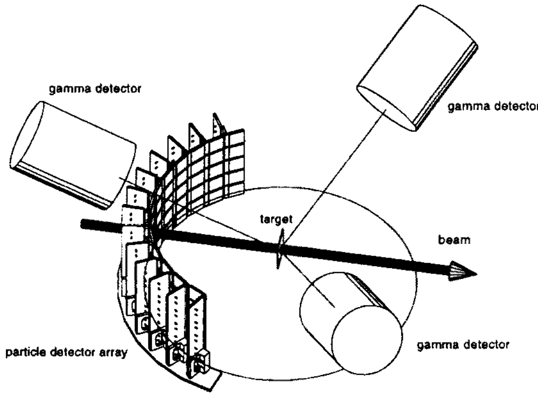

Fig. 3. The idea of CUDAC - particle detector array covering the backward angles working together with gamma ray detection system.

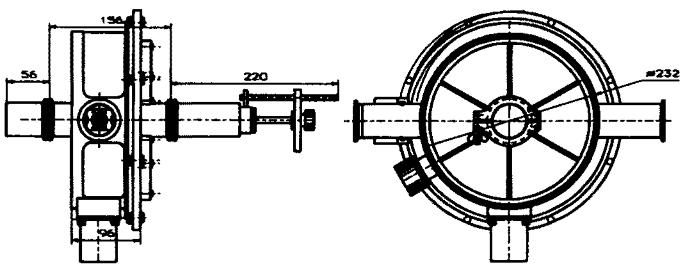

Fig. 4. CUDAC chamber: it allows for different gamma ray detector placement at low distances from the target.

trigger logic and the bit pattern unit. Adding a multiplexer and single ADC one can achieve particle energy information. Bias power supply, preamplifiers and fast/slow amplifiers are operational now.

REFERENCES

[1] P.A. Butler, Proceedings of the XXVII Zakopane School of Physics, *Acta Phys. Pol.* **B24**, 117 (1993) and references therein.

[2] F. Ajzenberg-Selove, *Nuc. Phys.* **475**, 1 (1987).

[3] J. Iwanicki, Z. Grabowski, *Heavy Ion Lab. Annual Report* 1995, p.17.